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FUSARIUM TUBER ROT OF POTATOES

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WHAT IS FUSARIUM ROT OF POTATOES?

FUSARIUM TUBER ROT of potatoes is a disease caused by a number of closely related molds or fungi.[1] Some of these fungi also attack the growing plant and cause the disease known as Fusarium blight or wilt.

WHAT IS THE EFFECT OF FUSARIUM ROT ON THE TUBER?

Fusarium tuber rot makes affected tubers unsalable or at least lowers their selling price and often causes their complete decay in the field, in transit, or in storage.

The disease generally is marked by sunken, shriveled, wrinkled, or broken areas occurring on the tuber surface. These areas may be of the same color as the healthy parts, or they may be greenish or brown to black, and on them may appear masses of whitish, or dark, or brightly colored mold. (Pl. I, figs. 1–4.)

The tissues underlying such discolored and sunken areas may be mushy, leaky, and grayish or light to dark brown, as in one of the Fusarium tuber rots of southern potatoes (Pl. II, fig. 1); they may be jellylike and light to dark brown or black, as in one type of the jelly end-rot of western potatoes (Pl. II, fig. 2); they may be soft and light colored to black, at times containing cavities lined with white or brightly colored mold; they may be dry, corky, and friable and dark brown to black; they may be dry and tough and brown to black, as in black field-rot of western potatoes; or, as in powdery dry-rot, they may be dry and brittle, with cavities separated by dried brownish tissue and starch and lined with whitish and fluffy or powdery molds (Pl. II, fig. 3). Whether only one of these types occurs, or a mixture of several, will depend upon the species responsible for the rot or the conditions under which affected tubers are kept. Fusarium tuber rot is usually dry at low temperatures and wet at high. It never is slimy, even when wet, and never has a bad odor; when accompanied by other fungi or bacteria there may be bad odors from them.

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[1] These fungi are known as *Fusarium* species. A fungus (plural, fungi) is a small, simple plant which lacks the green color found in more complex plants, such as our orchard, field, and garden crops. Molds, yeasts, toadstools, and mushrooms are good examples of fungi. Fungi can not make their own food, as green plants do, and many of them obtain it from living plants or their dead remains. Most fungi which obtain their food and energy from living plants are known as parasites, while the plants upon which they grow and feed are known as their hosts. Such fungi usually cause harmful changes in the structure, composition, and activities of their hosts, which are known as lesions. Such changes constitute disease. Thus, in the Fusarium tuber rot of potatoes, the fungi (*Fusarium* species) are the parasites which attack and feed upon their host, the potato tuber, causing spots or lesions, which are manifestations of the disease.

While the above descriptions apply to all types of Fusarium rot, the differences in symptoms that exist between tubers from various sections are often so characteristic that they warrant special mention and can even be made the basis of a rough classification.

Sometimes, in the wet and jelly types and in the black, dry, hard field-rot type, the affected tissue is sharply separated from the healthy tissue by a narrow water-soaked layer and can be removed very easily. In others, such as the wet, mushy type, the dividing line between healthy and diseased tissue is not sharply marked. In the early stages of powdery dry-rot the affected light-brown to black tissues are sharply set off from the healthy tissues by a layer of brown or black tissue.

In some types of rot, for example powdery dry-rot, the fungi have a tendency to rot the center or pith of the tuber faster than the outer or cortical tissue, so that a spot which is scarcely apparent on the surface may be underlain by an extensive wet region or by a rotted dry interior, full of cavities, surrounded by a shell of healthy cortical tissue. (Pl. II, figs. 3 and 4.)

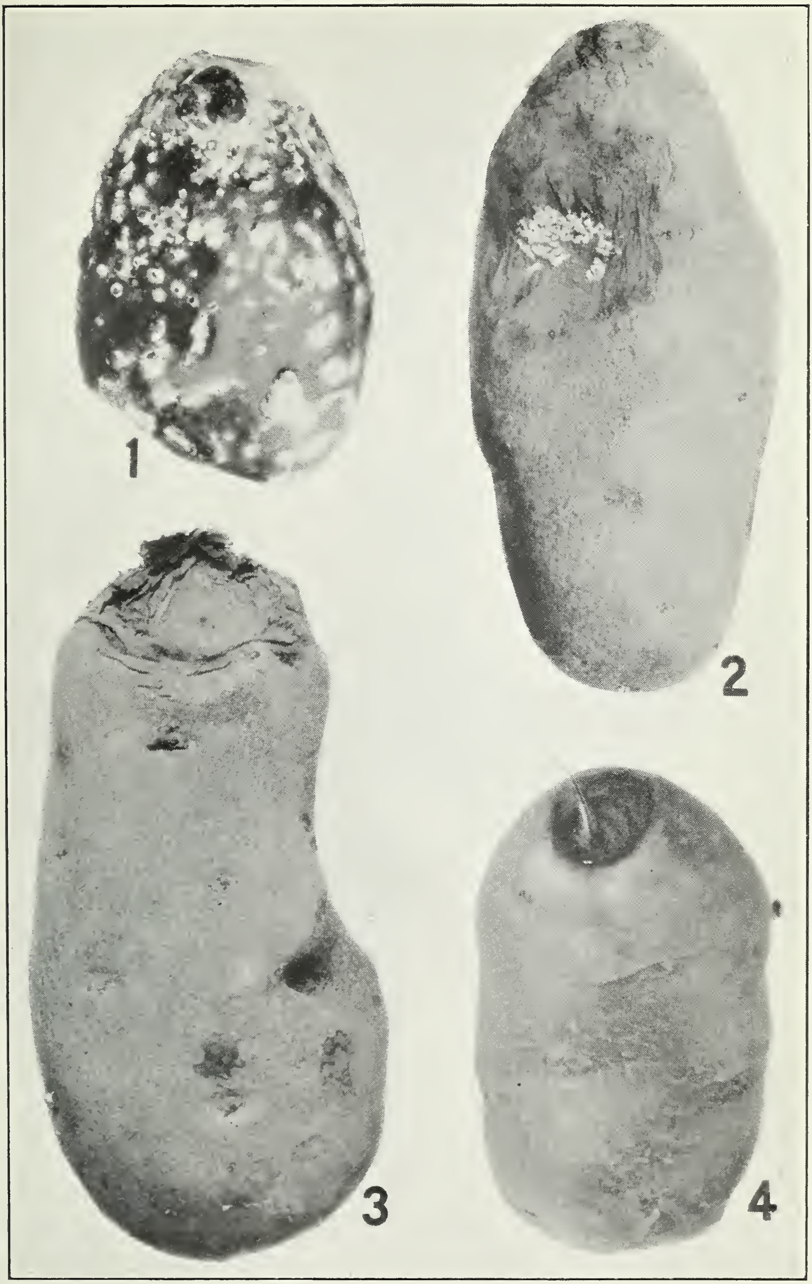
In other types, the rot progresses more evenly into the tuber, destroying the various tissues at a more or less equal rate. In such rots, the dried-out stage often is marked by layerlike, dry, tough remnants of the destroyed tissues. In some cases, as in the jelly-end type, the outer tissues are destroyed a little more rapidly than others, while in tubers produced by plants infected with Fusarium blight the rot progresses more rapidly along the ring tissues.

WHAT IS THE EFFECT OF FUSARIUM WILT ON THE PLANT?

Some of the fungi which cause Fusarium tuber rot also attack the growing plant and produce a disease known as Fusarium blight, or wilt, which decreases the yield by injuring or killing the plant before it has set or matured its tubers or by injuring the tuber-bearing stems (stolons).

In this disease the underground parts of the plant, or only the interior portions of the stem, both above and below ground, may be destroyed or their normal water-absorbing and conducting activities

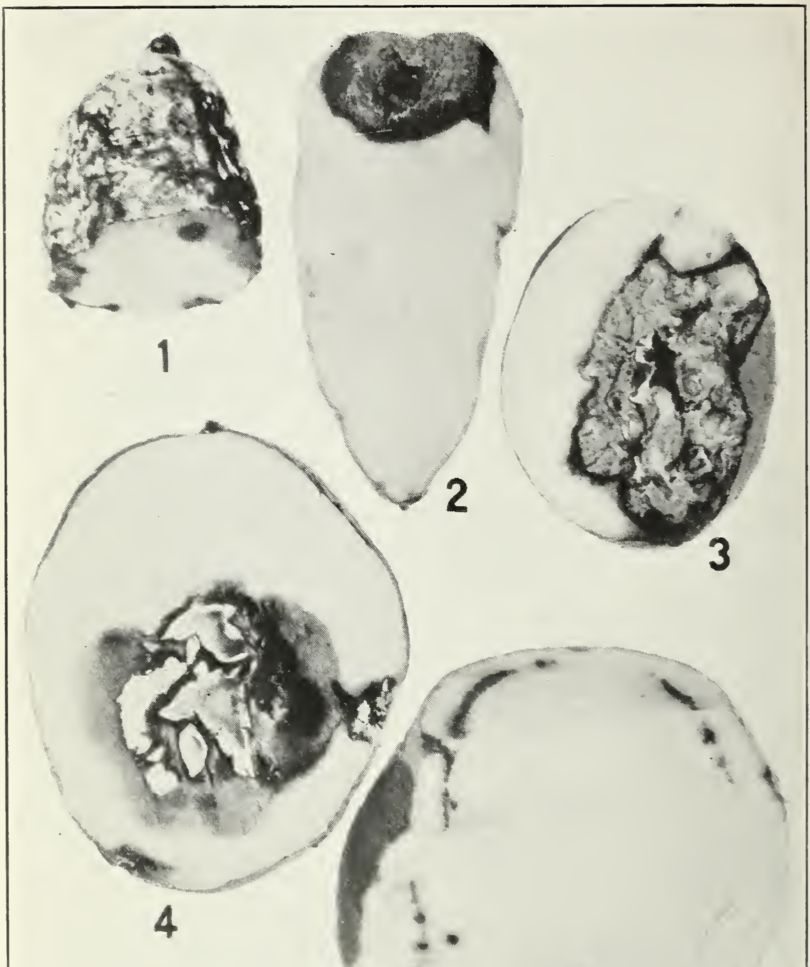
PLATE I.



FUSARIUM TUBER ROT. EXTERNAL VIEW.

FIG. 1.—Southern wet type (*Fusarium radicicola*). FIG. 2.—Dry or wet type (*F. trichothecioides, F. oxysporum,* and other species). FIG. 3.—Jelly-end type (*F. radicicola* and other species). FIG. 4.—Stem-end type (*F. radicicola* and other species).

PLATE II.



FUSARIUM TUBER ROT. SECTIONAL VIEW.

FIG. 1.—Southern wet type (*Fusarium radicicola*). FIG. 2.—Stem-end type (*F. radicicola*). FIG. 3.—Dry type (*F. trichothecioides* and other species). FIG. 4.—Wet type (*F. oxysporum* and other species). FIG. 5.—Fusarium blight or wilt (*F. oxysporum* and other species).

disturbed. The affected parts may be merely discolored or they may be blackened and decayed. At first, affected roots and stems may be wet and slippery, but later they become dry, brittle, and friable. As a result there is discoloration, rolling, and wilting of the leaves, frequently followed by the wilting and premature death of the entire vine.

The disease may appear at any time in the season, and once it has appeared death of the foliage may occur slowly and fitfully, or very rapidly and suddenly. The disease may appear so early that it destroys the seed piece or the sprouts before they emerge from the ground. Frequently it appears in young plants, which may die promptly or may live to maturity. Finally, it may not appear until three or four weeks before frost.

Tubers borne by blighted plants frequently show merely discoloration in the ring tissue, entering through the stolon (Pl. II, fig. 5), or they may show actual rot restricted to the ring tissue or involving all the tissues. The rot is marked by a sharply sunken spot at the stem end, which may be black, dry, and either hard or soft.

WHERE AND WHEN DOES FUSARIUM ROT OCCUR?

Fusarium tuber rot occurs in tubers from practically all potato sections of the United States. Probably most soils are infested with several species of Fusarium, though in some soils one or two species seem to predominate. The resultant predominance of different Fusarium tuber rots in the various potato sections of the country is probably due, among other things, to the fact that during the potato-growing season air and soil temperature and moisture favor one or two species rather than others.

Under storage and transit conditions powdery dry-rot is the most common Fusarium tuber rot in western potatoes, that is, in tubers from the Red River Valley, from western Nebraska, and from other western sections. Jelly end-rot, which predominates in long tubers of the Burbank type, and black field-rot, which is especially severe in the Idaho Rural variety, are western diseases. The mushy, leaky, grayish type of Fusarium tuber rot is predominantly a southern disease.

Fusarium blight or wilt occurs only in the warmer potato sections and is most severe in those having hot weather and heavy soils, such as the Grand and Uncompahgre Valleys of Colorado. It does not occur abundantly, if at all, in the earliest Florida crop, or in such cool potato sections as those of Maine or Oregon.

WHERE AND HOW DOES THE DISEASE START IN THE FIELD?

As pointed out above, species of Fusarium infest practically all soils, in which they feed upon either living plant parts or plant trash. They may be spread from field to field and from district to district by infected tubers and by practically any agency that carries and distributes soil, such as wind, water, man, insects, and birds.

In Fusarium blight the plant gets the disease either from diseased seed pieces or probably more often from infested soil.

WHEN AND HOW DOES FUSARIUM TUBER ROT GET INTO TUBERS?

Tubers grown on blighted plants may get Fusarium tuber rot through the stolons from the diseased mother plant. In some types of this rot the growing tuber may get the disease directly from the soil, the fungus entering through eyes, lenticels, or breaks in the tuber skin. In another type, such as powdery dry-rot, the fungus enters only through breaks in the skin; consequently, this type of Fusarium tuber rot is much more a storage and transit and less a field disease than the other types. It does occur in tubers, however, at digging time, but only following breaks in the skin made by jelly end-rot, black field-rot, black-leg tuber rot, freezing, and similar causes.

In view of the fact that these fungi occur so universally, it is practically impossible to get tubers which do not bear Fusarium fungi on their surfaces. Tubers which carry the spores or seedlike bodies or other parts of fungi on their surfaces are said to be contaminated.

A tuber may carry many spores or other parts of a Fusarium fungus on its surface and still be perfectly sound and healthy and remain so. Before the disease can develop in such a contaminated tuber, either in the field or after digging, infection must take place; that is, the fungus must enter the tissues and establish itself there. In case only spores are present, they must germinate or sprout and the resultant fungus must enter.

The skin of the tuber is an effective barrier to the entry of these fungi. Some of them can enter the tuber through lenticels, eyes, stolons, and breaks in the skin. Others, such as the fungus which causes powdery dry-rot, can enter only through breaks in the skin made either by other diseases, such as late-blight tuber rot, by other Fusarium tuber rots, by freezing, by scalding, or by digging and handling operations. Since all of them can enter most readily through wounds, Fusarium tuber rot is most frequently found in tubers that have been exposed to freezing temperatures or in those that have been carelessly and roughly handled. Wounds may be large enough to admit these fungi and still not be visible.

WHAT CONDITIONS FAVOR THE START AND DEVELOPMENT OF THE DISEASE?

Even though these fungi are present on tubers, they can not cause infection unless temperature and moisture conditions are favorable for the germination of their spores and the growth of the fungi.

None can grow nor can the spores germinate if not supplied with moisture, or if the temperature is 34° F. and below, or 102° F. and above. At 41° F. a few make a very small growth visible only after six days, and at 50° F. all make only a very slight growth. But while the growth made at temperatures between 41° and 50° F. is very small, it really is important, because it serves to establish the fungi in the tubers. For this reason, it frequently happens that tubers which appeared sound upon removal from cold storage or common storage rot very rapidly when brought out into higher temperatures. Even at temperatures below 41° F. these fungi are not killed, but can lie dormant for months.

All except two of the Fusarium fungi known to cause tuber rot grow best at about 77° F. Of these exceptions one causes blight of the plant and a soft rot of tubers; the other causes stem end-rot and black field-rot. They grow best at about 86° F. and they alone can grow at 97° and above, 102° being the upper limit for the former and 98° F. for the latter.

Following infection, some time elapses before visible symptoms of the disease appear. It may happen, therefore, that tubers are harvested, stored, or shipped which look sound but have become infected, and will develop visible signs of the disease later on if temperature and moisture conditions are favorable for the fungi.

Under the most favorable conditions signs or symptoms of the disease first become visible 4 or 5 days after infection. After 10 to 15 days the decayed regions are quite large, frequently involving one-half to three-fourths of medium-sized tubers. Tubers may be completely destroyed in 2 to 7 weeks if the temperature is about 77° F. and the air is moist.

DOES FUSARIUM TUBER ROT DEVELOP AND SPREAD AFTER HARVEST?

Some types of Fusarium tuber rot, such as black field-rot and jelly end-rot, seem to be primarily field diseases and do not develop or spread after harvest; others may continue to develop and spread in storage or in transit; still others, such as powdery dry-rot, primarily develop and spread after harvest. Tubers which appear sound, even though actually infected, when dug or loaded may show rot in two weeks if conditions are favorable for the rot, or months later, following a change from unfavorable to favorable moisture and temperature conditions.

WHAT SHOULD BE DONE WITH DISEASED TUBERS?

Affected tubers, even though unsightly, are fit for food provided the diseased parts are cut away. They should be disposed of as soon as possible to avoid greater loss, unless they can be stored in a dry place at temperatures between 32° and 40° F., which practically inhibit the growth of the fungi that are known to cause Fusarium tuber rot.

HOW CAN THE DISEASE BE CONTROLLED?

Since Fusarium tuber rot and Fusarium blight proceed from the soil, their control is a very difficult matter.

No one thing will control Fusarium blight. It is desirable that care be taken to avoid planting seed stock produced by blighted plants. Crop rotation and the practice of the best cultural methods known in order to increase the vigor and resistance of the plant to these soil fungi also are recommended. Finally, in the western sections the use of whole seed is recommended as a very effective means of reducing losses by blight.

No effective control measures are known for the control of those types of Fusarium tuber rot which are primarily field diseases. Crop rotation is recommended.

Since Fusarium tuber rot probably causes greater loss in the harvested crop than any other potato disease, its control is a very important matter. As already pointed out, some types of this rot can get started in the eyes, lenticels, and stolons, as well as through wounds, while others, such as powdery dry-rot, can enter only through wounds. Careful handling during and following the digging of tubers, to avoid cuts and bruises, therefore, is very essential. Tubers should not be handled as if they were stones. They are living things, and their skin, even though very effective as a protective covering, is quite delicate and easily broken.

It is advisable to sort out diseased and frozen tubers before storing the crop. Such tubers are subject to Fusarium tuber rot and may act as centers of infection for others.

The storage and transit types of Fusarium tuber rot can be controlled by storing tubers in a dry place at temperatures between 34° and 40° F. It should be remembered, however, that some Fusarium fungi can grow at these temperatures and that tubers which are infected may appear sound upon removal from such storage condition and then rot rapidly when exposed to higher temperatures.

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